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Compliments of R. J. Eilbeck

THE

MECHANICAL REDUCTION

OF

GOLD ORES.

THE
MECHANICAL REDUCTION

—OF—

GOLD ORES

—BY—

THE CRAWFORD MILL.

THE
MECHANICAL GOLD EXTRACTOR CO.,
47 BROADWAY,
NEW YORK.

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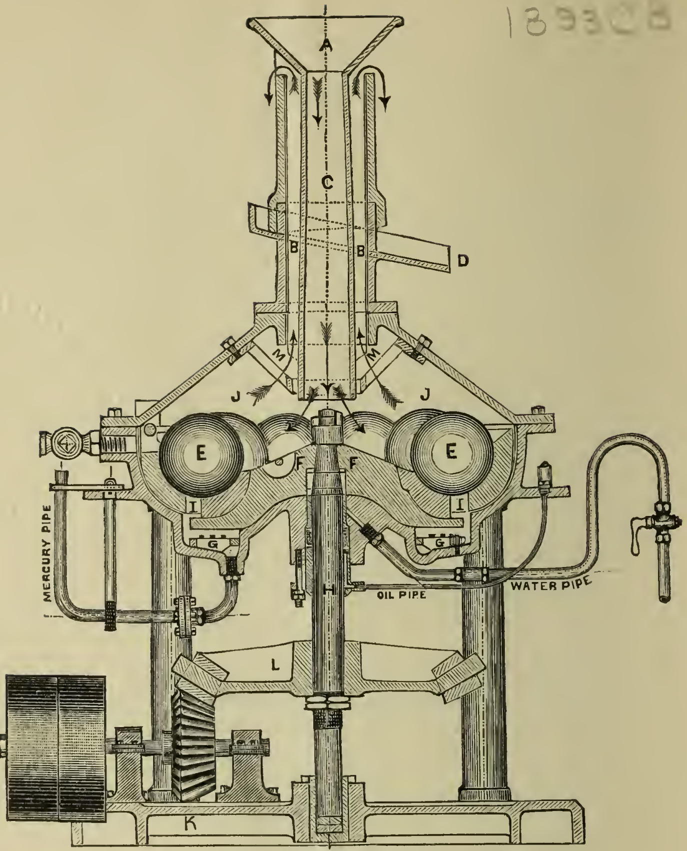

DESCRIPTION.

The ore is fed into the conical-shaped hopper "A," passes downward in th direction of the arrows, through the tube "C," and falls upon the rotary dis "F.F," which throws the ore with force under the balls "E.E," where it is groun to an almost impalpable powder (from 100 to 200 mesh), the gold particles, alone owing to their specific gravity, falling through the space "I I." into the mercur bath "G.G."

Rapid motion is imparted to the balls by the disc "F.F." which makes abou 100 revolutions per minute. The water entering through the water pipe passes unde the rotary disc "F.F." and flows over the mercury "G G." then upward through th opening "I.I." and filling the space "J J." carries upward the tailings in the direc tion of the arrows, through the neck "B.B." and flows out over the top; the tailing going to waste at "D."

The rotary motion of the water in the mill is checked by the flanges "M.M. and also by flanges on the neck of the hopper "B B." By this means, the violen agitation of the water ceases before it overflows the top, and thus the fine particle of light gold are not borne away, but settle back into the mill and eventually reac the mercury "H." is the vertical shaft which gives motion to the disc "F.F. Motion is imparted to the shaft "H." by a bevel gear "K." and "L."

THE CRAWFORD MILL
FOR
The Mechanical Reduction of Gold Ores.

Those who are familiar with the difficulties which to-day surround gold-mining, will recognize at once, that if a Quartz Mill has been invented which will treat low grade refractory gold ores more cheaply than the present Stamp Mill, while at the same time saving almost the entire gold contained in such ores, that then not only must all the present processes, whether mechanical or chemical, give place to the new mill, but a vast stimulus will be immediately afforded to the World's Gold Mining Industry.

It is not necessary to dwell upon the extreme importance to-day, to every human industry, of an invention which would considerably diminish the cost of producing Gold; not only would the mining camps of the Rocky Mountains and Brazil, of Africa, Siberia and India emerge from a long era of disappointed expectation, but a largely increased production of the precious metal may be relied on to stimulate every department of human activity,

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and to arrest that fall of prices everywhere which has been the most marked feature of the past fifteen years, which fall of prices is most reasonably to be ascribed to the increasing scarcity and consequent "dearness" of gold.

The experience of the working of the Crawford Quartz Mill, during the past year justifies the conviction that the problem of the cheap mechanical separation of gold from pyritous ores, has been at last solved.

Perhaps no better expression of the magnitude of the annual loss, resulting from defective appliances in gold mines, can be quoted, than the following from the London "Times":

> "*Notwithstanding all that science has done in improving the yield of gold from the ore, it is an admitted fact that, owing to the tenacity with which some of the richest and most refractory ores hold the precious metal, as much as 40 to 50 per cent. of the gold contained in the gross quantity of ore, treated throughout the world, is lost. To appreciate the importance of this waste, it should be borne in mind that more than 25 millions of pounds (Sterling) worth of gold is produced annually, so that the value of the proportion which escapes may be computed at from 15 to 25 millions every year.*"

The difficulty then by which the miner has always hitherto been beset, has not resulted from nature being over-niggardly in distributing gold in quartz, but has arisen entirely from the difficulty in extracting the gold when found. Had the wheat farmer been threshing with a machine which left half of his wheat in a chaff heap, the difficulty of profitable wheat raising would have been similar to that which the mine owner to-day encounters.

Nor is the waste of the hundred million dollars a year lost in the tailings of the mines, and of which loss probably thirty per cent. is incurred by this country, by any means the entire aggregate loss to be attributed to the present deficient processes in use. It is well within the mark to affirm that a mill which will save twenty per cent. more gold than the stamp mill, while working more cheaply, would result in opening ten profitable gold mines, where one is being worked to-day, and would further than this, retrieve from abandoned gold mining ventures all the world over, hundreds of millions of dead capital which has been invested unproductively in developing the quartz reefs. Briefly stated, the history of gold mining has been this ; The gold ores near the surface of the earth having been so acted upon by the atmosphere, that the pyrites whether of iron or copper, have oxidized, thus setting the gold "free," these ores for a distance of varying depth have yielded their gold cheaply to the action of the stamp mill, but the ores which underlie what miners call the "water level" while generally richer in gold, defy the treatment of stamps: Some other process therefore becomes necessary, which while more effective than the stamp, is less expensive than any known chemical process. It is at this point the Crawford Mill invites the attention of the miner.

The Mechanical Gold Extractor Co., has been incorporated under the laws of New Jersey for the purpose of introducing on the Continent of North America the Crawford Mill which after very numerous tests with a large variety of ores from all parts of the world, has established itself as the most economical and efficient separator in use today.

The process of extracting gold with the mill invented by Mr. Crawford has already attracted much attention in England and in some of the colonies of Great Britain. Perhaps no one in England has given the subject so much attention as Mr. Moreton Frewen, whose researches in the field of economic science are well known to students on both sides of the sea. Referring to the Crawford Mill, Mr. Frewen wrote recently :

> "I venture to think that Mr. Crawford has done more than merely invent a machine. He seems to me to have discovered a principle—a principle, not known to science, or if known, then, hitherto neglected. It is an evolutionary machine ; one that may rank in the history of this century with the inventions of Arkwright and Stevenson of Bessemer and Edison. Of course, the natural affinity or avidity of mercury for gold has been known for centuries past, but Mr. Crawford's machine now declares to the world for the first time this important fact : That by the sub division of quartz into infinitesimal particles, all the gold contained can be released from the quartz and caught by the mercury and that in short, given atomic pulverization, all gold is "free."

It is often asked why poor ores are profitable to work and rich ores so often worthless. The reason is not far to seek. The rich ores carry their gold in myriads of tiny particles, which are enclosed in metal envelopes (pyrites or sulphurets) while the low grade ores carry what little gold they have in a friable substance of pure stone, which is readily pulverized by the concussion of the stamps. Suppose that one particle of gold, as large as a pin's head, is laid in a brick, while on the other hand, forty granules of gold, each one-tenth of the size of a pin's head, are contained in a horse shoe. Here you have in brief the difficulties which confront the gold miner. The present appliance, the gravitation stamp, pulverizes the brick and captures the pin's head, but where is the sytem to break down, not a mineral, but a *Metallic* substance and break it down infinitely fine—and at no greater cost per ton than the stamp mill breaks the brick ? Such is the problem as wide as the earth's surface, which this mill of Mr. Crawford's appears to solve. I say nothing at present as to the other merits of this clever mill. I am now only remarking its power of fine grinding cheaply. * * * *

And while the significance of this statement may escape those who are not miners, I venture to affirm that in the entire range of dynamic science there is nothing more remarkable than this, nor more important, that a mill has been invented which will reduce daily 100 tons of metalized stone, to a "120 mesh," at a cost of $100, which cost includes labor, wear and tear and renewals. Now a 120 mesh means, that if we take an ordinary silk handerchief, the Crawford Mill will crush a ton of pyritic gold quartz so infinitely small that the entire mass will pass through the meshes of this handkerchief. Could anything apparently more fabulous be claimed for a mill than the power to reduce 100 tons to such fineness and for $100.00 ? Once verify the grinding powers of this Mill and it is no longer surprising that such a cheap crusher should also be a separator of unheard of cheapness.

The quartz having been ground exceedingly fine, as above described, and the gold having thus been freed from his matrix the precious metal is now separated, the lighter materials such as silica or even iron or zinc being floated away by water pressure from below, while the gold through its greater weight falls into the bath of mercury, there to be amalgamated. Wherever gold is associated with sulphur or other deleterious matter this device of water sorting by specific gravity operates most effectually. It follows then, that if the ore can be ground sufficiently fine, the sulphur, antimony and other sickening elements will be separated from the gold, however small the particles of gold may be, and the atoms of gold thus released from their envelopes or adherent substances, are caught in the bath of mercury. It is a well known fact that if any of the sickening elements such as arsenic or zinc are present in the ore, and are allowed to come in contact with the mercury, the mercury "sickens" and thus loses its power to absorb gold. This is prevented in the Crawford machine, and herein is the further secret of its great superiority over stamps. By an ingenious arrangement water is introduced into the mill under pressure, and flows evenly in an upward direction over the surface of the mercury. The particles of crushed ore, which have a less specific gravity than gold cannot reach the mercury, being forced upward by the pressure of the ascending column of water, until having been crushed infinitely fine by the balls, they float off with the water leaving behind them the weighty particles of gold. And whilst the water enters the mill with a considerable upward pressure, the direction of this pressure is reversed by the lateral sweep of the balls, and is also exhausted by expansion in the wide dome; thus the very fine particles of gold are prevented from being ejected from the tailings.

The results thus far obtained by the use of this Mill in the field, illustrate its superiority far more conclusively than any descriptive statement of its parts.

A large number of experiments were made in England last year, when more than forty different ores from all parts of the world were treated by the Crawford Mill. Take, for instance, the Australian ore from the Ravenswood mine; this ore which will not yield 25 per cent. of its gold in an ordinary stamp mill, yet yielded upward of 90 per cent. to the Crawford Mill, and this without roasting or chemical treatment of any kind. Special reference is made to the Ravenswood ore because it has not only defied every mechanical process hitherto, but it is so loaded with heavy metallic components that even to treat it chemically is enormously costly. An analysis of this ore is instructive:

Iron, - - - -	25	per cent.
Lead, - - -	1	"
Zinc, - - - -	8	"
Arsenic, - - -	7	"
Sulphur, - - -	25	"
Total,	66	per cent.

It would be hardly possible to take a number of metallic compounds and build up a more impossible mixture than nature has in this instance blended with gold.

This is the case of a rich but highly metallized ore: Let us, however, go to the other extreme and take the case of another Australian ore—the ore of the Mount Morgan Mine,—the greatest gold mine, probably, that the world has ever known. The gold in this mine appears to have been ejected from the interior of the earth in the form of steam. It is distributed in the tiniest invisible particles, throughout a matrix of soft chalk, or pumice stone; but for the extreme minuteness of the gold particles, this is an ore which, being absolutely "free milling," would yield its gold to a stamp mill more readily than almost any other. As it is, however, a stamp mill will not touch it, and it is being treated in bulk by chlorination. The first test with the Crawford Mill gave 82½ per cent., the second, under a slighter pressure of water 92½ per cent. of gold saved.

Some of the ores tested were very rich, others poor. Some highly refractory and others, owing to the nature of the matrix, of such a composition that any stamp mill would be useless to deal with them, and only a costly chemical process could be resorted to, yet with these different ores results have been obtained in the Crawford Mill, varying from 70 to 98 per cent.

Further, the Crawford Mill is extremely portable and light. This means not only the saving of a large capital outlay in the first cost and in transportation, but also in the erection at the mine, both in the cost of foundations, and the little time required to commence work. While the weight of a Crawford Mill equal to a capacity of 2½ tons per 24 hours, does not exceed 5000 pounds, and an 8 ton mill 11,000 pounds, the mill itself can be readily removed in sections to be re-erected. Hence the mill can be, with great ease, carried into mountainous districts, hitherto inaccessible to stamp batteries, and the driving power required is also considerably less than that of the stamp mill. Another important feature is the low consumption of water. This must always vary according to the nature of the ore, but may be taken at from 500 to 1,500 gallons per ton of ore crushed, whereas the stamp mill requires not less than 2,000 to 8,000 gallons of water per ton.

Another not unimportant advantage of the mill is that the tube by which the amalgam is drawn off is securely padlocked ; thus no amalgam can be surreptitiously abstracted.

Perhaps no field for gold mining seemed less promising than that of Marmora in Ontario, Canada, where, with plenty of gold ore in sight, the ore being low grade and very refractory had always defied profitable treatment with stamps or other mining devices. The result of the erection of four small Crawford Mills in this locality, in the earlier part of last winter has been to demonstrate not only the success and usefulness of the mills but to make it apparent that there is a promising gold field in Ontario. The story of the operations in

Canada are told in the following words of Mr. A. W. Carscallen, a banker at Marmora, whose long residence, success and conservatism impart the greatest reliability to his statements :—

"Last winter we used a saw mill which was idle during the cold weather, and placed in it four (4) of the smaller mills. Using water power, we operated the mills at slight cost, but you can readily understand, that amid such surroundings the facilities available for testing mining apparatus were of the poorest character.

While we had sleighing, we teamed the ore from the mines to the mill, a distance of about 6½ miles.

The mills were operated night and day, needing no attention from the man in charge, save the regular oiling of the bearings ; in fact, there is scarcely any limit to the number of mills one man can look after.

Our ore is refractory and very difficult to grind, being especially hard on the wearing parts of our stone breakers ; but I find the mills reduced it readily to a very fine powder.

We sampled the tailings from each mill every hour, and assays were made at different times in different places, they invariably proved that we were saving over 90 per cent. of the gold, many of our returns showing 'just a trace of gold only.'

The ability of the mills to grind to such extreme fineness, thus separating the gold completely from the ore, enabled us to effect the largest saving ever known in this mining section. The assays from one run showed over 95 per cent. Considering the crudeness of our attachments and machinery and the general lack of facilities under which we labored, I was more than pleased with our showing, and am convinced that with a complete plant of large capacity at the mouth of our mine, conducted on true mining principles, a greater return for the money invested can be assured than in any other enterprise known to me.

The mills ran constantly and smoothly, performing their work without any trouble, and requiring little or no attention. The wearing parts are not at all expensive, considering the fine grinding and the work done, and our whole experiment extending over many weeks was most satisfactory. I am confident that when the mine owners of this continent become acquainted with this mill, and have tested it as thoroughly as I have, your out-put will need to be large, indeed, to supply the demand."

Yours truly,

(Signed) A. W. CARSCALLEN.

STATEMENT OF GOLD ORES TREATED

AT THE WORKS OF THE

Mechanical Gold Extractor Co.,

589 HUDSON STREET, N. Y. CITY,

During the six months ending Jan. 1, 1893.

Date.	*Location of Mine.*	*Character of Ore.*	*Gold per Ton.*	*Per centage Saved.*
July 24.	Virginia.	Iron Pyrites and Galena.	9.50	.79
" 24.	"	Iron Pyrites.	23.97	.82
" 24.	"	"	75.65	.98
" 24.	"	"	14.47	.88
" 25.	Warley Mine, Va.	Free Milling and Pyrites.	26.80	.95
" 28.	Woodman Mine, Va.	Iron Pyrites.	37.90	.92
" 29	Arizona.	Iron and Copper Pyrites.	4.13	.65
Aug 1.	Georgia.	Zinc and Antimony Blend Free Milling.	121.95	.98
" 3.	Slate Hill, N. C.	"	10.33	.95
" 5.	Gold Hill, M Co , N. C.	Copper Pyrites.	37.21	.95

Date.	*Location of Mine.*	*Character of Ore.*	*Gold per Ton.*	*Per centage Saved.*
Aug. 5.	Gold Hill, M. Co., N. C.	Concentrated Tailings.	4.13	.89
“ 8.	Virginia.	Free Milling.	10.33	.90
“ 10.	Colorado.	Free Milling.	53.74	.91
“ 10.	New Mexico.	Galena, Arsenical Pyrites and Iron Sulphides.	15.50	.90
“ 13.	Sandia M. & S. Co, New Mexico.	Arsenical Iron and Copper Pyrites, with Maganese Oxides.	20.67	.85
“ 16.	Sampson Mine, Arizona.	Free Milling.	39.27	.92
“ 18.	Virginia.	Concentrated Sulphurets.	3.62	.81
“ 22.	“	Iron Pyrites.	6.20	.84
“ 22.	Caledonia, Va.	“	4.13	.98
“ 22.	Idaho.	Free Milling.	10.33	.90
“ 24.	Virginia.	Sulphurets.	4.13	.96
“ 24.	Powhattan L. & M. Co., Va.	“	5.17	.90
“ 25.	“	“	2.07	.75
“ 25.	“	“	2.07	.98
“ 25.	“	“	4.13	.98
“ 25.	“	“	5 17	.90
“ 25.	“	“	4.13	.88
“ 25.	“	“	3.10	.98
“ 25.	“	“	4.13	.88
“ 25.	“	“	4 13	.88
“ 26.	North Carolina.	Iron Pyrites.	7 23	.87
“ 29.	Elkhorn Mine, Oregon.	“	343.12	.86
“ 29.	“ “	Sulphurets.	45.47	.87
“ 29.	“ “	“	10.71	.80
“ 29.	“ “	Concentrates.	47.11	.73
“ 30.	North Carolina.	Iron Pyrites.	18.60	.87
“ 31.	Black Rock, Col.	Galena and Tellurides.	53.74	.92
“ 31.	Colorado.	Free Milling.	64.08	.87
“ 31.	Virginia.	Sulphurets.	2.07	.98
Sept. 1.	Virginia.	Extremely refractory.	8.27	.88
“ 1.	Sandia M. & S. Co., N. M.	Sulphurets.	16.54	.87
“ 1.	Gold Bullion M. Co,, Ariz	Free Milling.	24.80	.94
“ 6.	North Carolina,	“	3.10	.98
“ 8.	Virginia.	“	83 71	.97

Date.	*Location of Mine.*	*Character of Ore.*	*Gold per Ton.*	*Per centage Saved.*
Sept. 8.	Cheyenne, Wyo.	Arsenical Pyrites.	8.27	.88
" 8.	Oregon.	" "	8.27	.82
" 9.	Kansas.	Free Milling.	14.47	.93
" 9.	Dahlonega, Ga.	Iron Pyrites.	4.13	.88
" 12.	Gold Hill M. Co., N. C.	Copper Pyrites.	2.60	.92
" 14.	"	Tailings, Copper Pyrites.	1.55	.95
" 15.	North Carolina.	Free Milling and Iron Pyrites.	29.97	.93
" 15.	Gold Hill M. Co., N. C.	" "	66.14	.91
" 17.	Dahlonega, Ga.	Iron Pyrites.	12.48	.84
" 17.	"	"	8.27	.88
" 20.	"	"	16.54	.88
" 21.	Nova Scotia.	"	13.43	.92
" 22	Gold Hill, N. C.	Free Milling and Iron Pyrites.	20.67	.90
" 23	"	Free Milling.	13.43	.89
" 23	Gilmore Mine, Va.	Free Milling and Pyrites.	14.47	.93
" 23.	Colorado.	Free Milling.	35.14	.95
" 23.	Tagus Mine, Va.	Free Milling and Iron Pyrites.	4.13	.95
" 23.	California,	Free Milling.	47.54	.95
" 26.	San Salvador.	Very refractory.	4.13	.88
" 29.	North Carolina.	Sulphurets.	14.47	.86
" 30	" "	Free Milling.	8.27	.94
" 30.	Mexico.	Refractory.	16.54	.90
Oct. 1.	"	Concentrates.	24.80	.95
" 3.	North Carolina.	Sulphurets.	40.13	.95
" 3.	Nicaraugua.	Iron Pyrites and Galena.	397.90	.91
" 4.	Nova Scotia.	Concentrates.	41.34	.90
" 4.	Colorado.	Free Milling.	12.40	.95
" 8.	Gold Bullion M. Co., N.M.	"	37.21	.97
" 14.	Gastonia, N. C.	Concentrates.	31.00	.87
" 14.	"	Free Milling.	4.13	.96
" 14.	"	Iron Pyrites.	4.43	.98
" 15.	Gold Hill, N. C.	Highly Sulphuretted.	6.20	.95
" 25.	Oregon.	Iron Pyrites.	20.67	.81
" 26.	"	"	28.94	.93
" 29.	Charlotte, N. C.	Sulphuretted.	16.54	.94

Date.	*Location of Mine.*	*Character of Ore.*	*Gold per Ton.*	*Per centage Saved.*
Oct. 31.	Cunningham Mine, N. M.	Sulphuretted.	26.68	.95
“ 31.	“ “	Free Milling.	12.40	.95
Nov. 2.	Etta Mine, S. Dakota.	“	51.67	.92
“ 2.	“ “	“	10.33	.95
“ 2.	Ontario, Can.	“	4.13	.95
“ 5.	Ouray, Col.	Sulphuretted.	6.20	.92
“ 6.	Georgia.		12.40	.92
“ 10.	“		7.23	.86
“ 12.	Little Joe Mine, Col.	Galena and Iron Pyrites.	82.68	.90
“ 16.	Hughes Mine, Virginia.	Free Milling and Iron Pyrites.	26.87	.85
“ 17.	Montana.	Tailings,	10.33	.80
“ 23.	Moltke Mine, Col.	Sulphuretted.	2.07	.90
“ 25.	Providencia Mine, Sonora, Mexico.	Free Milling.	82.68	.85
“ 25.	Providencia Mine, Sonora, Mexico.	“	221.17	.93
“ 25.	Providencia Mine, Sonora, Mexico.	“	16 54	.88
“ 29.	Virginia.	“	4.13	.96
Dec. 5.	Oregon Gold Mining Co.	Sulphuretted.	16.54	.88
“ 5.	Gilmore Mine, Va.	Free Milling.	8.27	.95
“ 8.	Colorado.	Tailings.	10.33	.85
“ 12.	La Clara Mine, U. S. Columbia.		62.01	.84
“ 14.	Russell Mine, Virginia.	Sulphuretted.	6.20	.92
“ 16.	Arizona.	Free Milling.	6.20	.92
“ 22.	Russell Mine, Virginia.	Tailings.	3.10	.95
“ 29.	Cunningham Mine, New Mexico.	Sulphuretted.	4.13	.90

The great advantages of the Crawford process may be summarized as follows:

(1) Minimum outlay in capital.
(2) Great economy in transport and erection.
(3) Low consumption of water.
(4) Small power required for driving.
(5) Extreme fine grinding.
(6) Simplicity of construction.
(7) Ease of management.
(8) Greater efficiency than any other mechanical process.

The Crawford Mills are manufactured exclusively by the Bouton Foundry Company, Chicago, Illinois.

The price of the mills f. o. b. Chicago is as follows:

8 in. mill, with a daily capacity of about 2½ tons	$1,000
12 in. mill, with a daily capacity of 8 to 12 tons	$2,500

The Company has established Metallurgical Works at 589 Hudson Street, New York City, where sample ores will be treated free of expense. Its agents also, named below, have complete working plants, and are prepared to test all ores that may be shipped them.

F. R. Lingham, Helena, Montana.

Morton E. Post and G. D. Haven, Salt Lake City, Utah.

B. F. Cook, Hillsboro, New Mexico.

Alexander Carscallen, sole agent for Canada, has a plant at Marmora, Ont., under his own supervision, a plant at Waverly, Nova Scotia, in charge of Capt. Geo. Macduff and a plant temporarily located at Rat Portage, Ont., in charge of H. T. Stuckland.

W. H. Kimball, 47 Broadway, New York City, sole agent for the Southern States, will shortly establish several plants in that section.

Correspondence is invited and all further information will be furnished by

The Mechanical Gold Extractor Co.,

ERASTUS WIMAN, President. **W. O. ROSS, Secretary.**

47 Broadway, N. Y. City.

TESTIMONIALS.

Helena, Mont., July 12th, 1892.

Gentlemen :

After the very satisfactory test, under my personal observation, of the Crawford Gold Mill, on ten tons of ore, from the Mac Mine, I unhesitatingly say that, I think it is just the mill wanted by gold mining men, and at the next meeting of the directors of the Mac Mining & Milling Company, I shall strongly advocate the purchase of four or more of your mills to replace the twenty stamps recently destroyed by fire.

Respectfully,
(Signed) A. McLean,
Pres't Mac M. & M. Co.

NOTE :—Two Mills have already been purchased by this Company.

THE SALISBURY GOLD MINING CO., Limited,
Montagu, N. S.

Windsor, Nova Scotia, 15th Sept., 1892.

Dear Sir :

This Company had four tons and four cwt. of ore from their property at the Montagu Gold District, crushed in the Crawford Mill, which yielded four ounces and seven pennyweights (4 oz's 7 dwt's) of gold.

A sample of the tailings which ran through during the crushing, yielded by assay of Messrs. Davenport & Williams, of Boston, the equivalent of 0.033 oz. of gold to the ton.

This evidence of the capability of the Crawford Mill to extract all but a trace of the gold which the ore may contain, must be considered of importance by all who are interested in the question of improved methods of mining gold from the ore.

The crushing alluded to was effected under the supervision of the company through trustworthy agents.

I am, dear sir, yours truly,
(Signed) Wm. D. Sutherland,
Secretary.

Geo. Macduff, Esq., M. E.,
Representative M. G. E. CO.

New York, October 9th, 1892.
33 Broad St.

Dear Sirs :

I have pleasure in reporting that our Company is well pleased with the treatment of their ore by your Crawford Mill. We were all extremely doubtful whether, by means of a purely mechanical process alone, so high a saving could be effected on our ores ; however, as we narrowly watched the entire process during the treatment of our ores, and have had samples of their "heads and tails" assayed by outside metallurgists, who, confirmed the accuracy of your reports, we are bound to believe the Crawford mill is a phenomenal one, and the claims made for it are not exaggerated.

The following is a statement of the ores treated for us, and although the quantities were not large, we are satisfied the same high per centage of saving can be effected when the mills are working at the mine.

Free milling ore, containing a very small per centage of sulphurets, gold value	$39 27.	92 per cent. saved.
Refractory ore, consisting of arsenical pyrities, iron pyrities, copper pyrities and manganese oxide, gold value	20 67.	85 per cent. saved.
Refractory ore	16 54.	87 per cent. saved.

Our Board are so well satisfied with these tests, that they intend to place one or more of your mills on their mines at an early date.

Yours very truly,
SANDIA MINING & SMELTING CO.
Theo. Honegger, Sec'y.

GOLD BULLION MINING CO.,
72 Broadway.

New York, October 18, 1892.

Sup't of the
Mechanical Gold Extractor Co.,
Dear Sir :

After having repeatedly tested the Crawford Mill on my Company's ore, I can consistently recommend it as the best gold mill I have ever seen or experimented with, and it is difficult to conceive in what respect it can be improved upon, excepting, possibly, in hood and feeder. As I practically assumed full charge of your mill while our ore was being run through, and having for days at a time, been present at your Works, witnessing the treatment of numerous other ores, I have had the fullest opportunity of demonstrating to my own satisfaction, that the principle of construction both in theory and fact is sound, as proven by actual mill work; and as the result of my own observation, I am convinced that the Crawford will prove a most profitable investment to those who use it, and, naturally, in the course of time, take the place of the older inventions and appliances, now in such general use.

I take pleasure in being enabled to state that the following results, under my personal inspection as above stated, were obtained in treating our common ores by this process:

Free milling ore, fine gold, assay value,	$34 87,	97%	saved.
" " " " " " "	26.30,	95%	"
" " " " " " "	38.21,	95%	"

In consequence of this clear demonstration of the mill's merits, our Company proposes to establish shortly, three large Crawford mills at our Mines in Arizona, following up with three more and so on, as our output increases.

I would also state, that in addition to the high saving powers of the mill,—its simplicity of structure, ease and economy of running, fine grinding, and perfect amalgamation, with minimum labor, power and water required, have been most carefully studied; the result so far as my opinion goes, is, that the claims of the Company in favor of their mill are based on facts.

Your obedient servant,
(Signed) Capt. W. M. Griswold,
General Agent.

Report of L. J. BOYD, M. E. F. G. S., Member Irish Geological Society.

Montagu, N. S., September 17, 1892.

The principle object of the following remarks is not to promote any prejudice against the majority of Gold Milling processes or machines, * * * but it is the intention of the writer, to as briefly as possible, compare the principles in relation to the system of Stamps "gravity or crushing" with that of "rotary" by introducing the results of certain tests and experiments recently made and conducted by skillful hands, of the "rotary" principle, with the object of determining the most economic and most effective system of gold saving.

Such results give needful information and knowledge, not only to the experienced, as well as the inexperienced mine and mill managers, and those interested in gold mining in general, but more particularly, to the directors of gold mining companies, who, as a rule, are not possessed of technical knowledge of milling and amalgamation, sufficient to insure themselves against the almost overpowering persuasion of the representative of new inventions. * * *

The main question of importance involved in gold mining is "how to prevent the loss of gold?" and under this heading the writer means to compare in a general way the difference between stamp milling and rotary. Assay returns of the tailings from many of the Stamp mills in Nova Scotia, show a direct loss of, in some instances, thirty per cent., which may be partly attributed, firstly, to careless milling and inexperienced amalgamation, and secondly, to the fact that a large amount of free gold passes away, which is imbedded in the small particles of the crushed rock and gold bearing sulphurets. The nearest attempt to obtaining the most perfect results from stamp milling in Nova Scotia can be seen at West Waverly, where high speed crushing has been introduced, which, together with the perfect and complete, economic system of milling, has reduced the gold loss at that mine to almost a minimum. Still, there is room for improvements in stamp milling in general, and such are to be found in the "Crawford Rotary Mill," which has been introduced into Nova Scotia, within the last two months, by Mr. H. T. Strickland, of Peterboro, whose energy in placing it before the mining world, and thorough competency as a practical miner must be appreciated. This mill has recently undergone a severe and critical test, in which Captain Macduff rendered invaluable help in the retorting, smelting and necessary calculations for the completion of the test.

The advantages of the "Crawford Mill" are many, the principle set forth being based on the soundest logical reasoning and so thoroughly practical that it defies the keenest criticism, and meets the requirements so long sought after, in the fact, that from actual experience of this mill, and from the most careful study of its operation, *it may be pronounced almost perfect as a "gold saver."*

The economy of its system of working, minimum degree of power required in proportion to stamp mills of equal capacity, its enormous efficiency (being proved by actual work over the majority of gold milling processes), the simplicity of its construction, which may be seen by its having only three movable affective parts including the balls, no necessity for amalgamation plates or screens, economy as regards the space it occupies, the abolition of heavy foundations, holding down bolts, stays or otherwise, and the cost of management being computed to be less than any crushing mill in existence.

The use of this mill in Nova Scotia, either as a substitute for the present system of stamp milling, or annexed to such process for the treatment of their tailings or concentrates, would be an unquestionable boon to investors in gold mines, considering the minimum outlay in capital required for its adoption, and the very reduced rate of expenditure in working it. If it be the general belief that twenty per cent. of loss is incurred in stamp milling in Nova Scotia, what a fabulous amount of wealth must daily be running to waste. The Crawford Mill being assumed to have a saving efficiency of from eighty-five to ninety five per cent. of the mine run, can it not be clearly seen that an enormous advantage must accrue from its adoption, even were it only employed to treat the tailings of almost every stamp mill now in operation.

The main principle of this mill may be explained in a few words. It is constructed on the "Pan-type" principle, the ore crushing being effected by steel balls set rotatively on two half circle annular grooves, the inner one being the periphery of a convex disc, running at a speed of about 112 revolutions per minute, the outer a fixed ring. A space between these two "seat grooves" of one-half inch forms the entrance to an annular trough containing quicksilver and placed at the bottom of the pan, below the ball seat.

The transmitted power being below the pan, the ore, broken to the size of not more than 1¼ cubic inches, is fed in through a hopper head, falls on the pan about eighteen inches or two feet, and comes in contact with the crushing balls. A steady stream of water under pressure enters the mill from below, plays over the quicksilver, and then flows upward into the body of the mill. The ore is held in suspension until it is ground into impalpable powder, by the balls; the gold particles alone, by their specific gravity, dropping down into the naked quicksilver. The sand as residue, instead of leaving the mill at the point below the crushing level, through screens or amalgam plates, as in stamp or other crushing systems, has to rise with the water through a grating, and flow off at the feed elevation. The quicksilver being introduced through a small pipe outside the pan, can be let off whenever necessary, retorted, and fresh put in, without stopping the mill.

The capacity of the mill experimented on in Waverly was an eight inch, meaning the diameter of the crushing balls, nine in number, weighing seventy-five pounds each. The quantity of ore treated will be seen in the list of details taken during the experiment and which speak for themselves. The speed of the mill, in my opinion, might be reduced to less than one hundred revolutions The wear and tear of the mill, I mostly attribute to the defective condition of the castings, but, notwithstanding this important part for which I shall make allowance, the results were simply wonderful. I can only add that I am personally perfectly satisfied with this system of ore treatment and should advise its adoption to tailings in particular, and I feel justified in writing this report, as the experiments have been carried on, under my personal superintendence.

(Signed) L. J. BOYD.

DETAILS OF TEST WITH AN EIGHT INCH CRAWFORD MILL.

Nominal capacity of mill, 2½ tons.
Commenced crushing, 7.20 A. M., July 20, 1892.
Finished, 10.52 A. M.
Time crushing, 3 hours 32 minutes.
Weight of material, 1,248 pounds.
Class of mineral, Mispickle and Slate.
Proportion, Slate 2. Mispickle, 1.
Revolutions per minute, 122.
Amount crushed per minute, 5.88 pounds.
" " " hour, 352.80.
" " in 24 hours, 4.23 tons.
Gold retorted, 11 dwts. 7½ grs.
Gold smelted, 11 dwts. 6 grs.
Amount gold per ton, 1 oz. 0 dwt. 4½ grs.
Weight of quicksilver used, 128 lbs. 8 oz.
Loss of quicksilver, nil.
Weight of coarse concentrates, 21 lbs, } 79 lbs.
" " fine " 58 " }
Coal consumed, .16.
H. P. per hour, 2.
Average height of water on sill, ⅜ inch.
Amount of water used per minute, 1 gallon.
Amount of water in running down during 1 hour, 2 gallons per minute
Engine speed per minute, 150 revolutions.
At reduced speed per minute, 132.

Gold saved from similar ore at the Montagu Stamp Mill, 9 dwts. 11 grs. per ton, showing a difference over 100 per cent. in favor of the Crawford Mill.

(Signed) L. J. BOYD, M. E.

RAT PORTAGE, ONT., October 22d, 1892.

H. T. Strickland, Esq.,
Representative Mechanical Gold Extractor Co.
Peterboro, Canada.

Dear Sir :

I am very glad to say to you, that the test of the Crawford Mill made here during this month upon the gold mining ores of this vicinity, has been highly satisfactory. I have given personal attention to several of them, taking charge of the run upon the ore of the "El Divir" Mine, and am now more than pleased with the mechanical construction and ease of operation, *aside from the almost perfect yield given by the mill.*

As confirming what I think of this Extractor, I have ordered one of the large mills for prompt delivery and use at the El Divir Mine, as indicated in my proposition made your Company to-day and will be happy to add more of them as soon as I can make room.

Very truly,
(Signed) J. H. WEBSTER.

RUSSELL HOUSE,
RAT PORTAGE, October 28th, 1892.

H. T. Strickland, Esq.,
Representative Mechanical Gold Extractor Co.
Peterboro, Canada.

Dear Sir : We take pleasure in saying the Crawford Mill has successfully treated the ore from our property known in this district as "The Bull Dog" *saving within 60 cents of its assay value.* We have ordered two of the twelve inch mills thus confirming our belief in their merits ; would further state we personally saw most of the tests made by the mill here, and the results have been in every case entirely satisfactory.

Yours very truly,
(Signed) BARNES & UPTON.

INTER REPUBLIC GOLD MINING AND MILLING CO.,
LOS CRUSIS, N. M., October, 6th, 1892.

Messrs. B. L. & G. D. Cook,
New Mexico Agents, Crawford Mill.
Rialto Building, Chicago;

Gentlemen ; Herewith letter from Hon. M. O. Otero, Los Vegas, which explains itself I have to-day written him that your mill saved *over 90 per cent. of our ores* and that it was satisfactory.

(Signed) W. H. H. LLEWELLYN,
Prest.

Rat Portage, Ont., October 24th, 1892.

A. W. Carscallen, Esq.,
Canadian Agent Mechanical Gold Extractor Co.,
Marmora, Ontario, Canada.

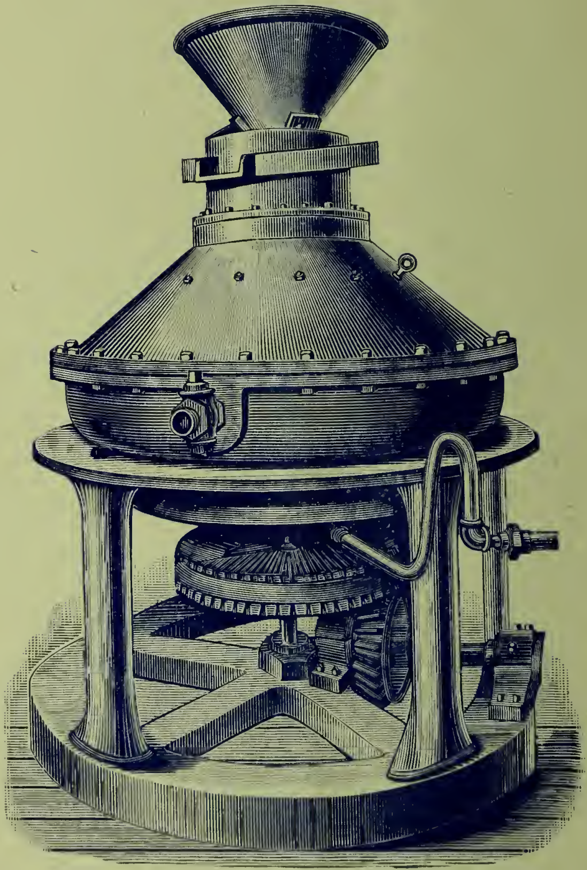
Sir: During the past two weeks I have paid special close attention to the operations of the "Crawford Mill" whilst a series of tests were being made on Lake of the Woods gold ores. Mr. Strickland, the gentleman in charge of the machine, was kindly permitted by the directors of the Lake of the Woods Reduction Works Co., to set up and operate his mill at their works, and tests were made on ores from a number of mines in quantities of from a half ton upwards. The results were entirely satisfactory and fully equal to what is claimed, by the inventors, can be accomplished with the mill. Assays made from the headings and tailings, show that from *ninety-one to ninety-eight and one-half per cent. of the values were saved.*

The principles on which the "Crawford Mill" is constructed are evidently based upon the theory, now generally accepted for fact, that gold contained in sulphuret and arsenical ores, is mechanically and not chemically combined with them, and the apparent object to be accomplished with this machine is to reach such a degree of fineness in pulverization, as to free the most minute particles of gold, leaving them in a state to be easily absorbed into the bath of quicksilver in the bottom of the mill.

This mill, notwithstanding its simplicity, combines in itself a Pulverizer, Grinder, Amalgamator, Settler and Cleaner up, and is apparently far in advance of any other known process for saving the float or flour gold of which there is a valuable percentage in all Lake of the Woods ores. The simple and perfect principle for saving the fine gold is the "genius" of the machine, everything going throngh the mill is ground to an impalpable fineness.

As all the mines which have yet been discovered in the Lake of the Woods district, are chiefly composed of sulphurate ores, it is about safe to say that with the "Crawford Mill" all of the ores in the district of which we know are free milling. It is unnecessary for me to here enter into a calculation of the cost per ton for the reduction by this process, as it is a mere matter of figures, and can be easily accomplished by any one who will send for a catalogue of the Company, showing price list, and capacity of their different sizes of mills.

I am, Sir, Yours very truly,
(Signed) WM. YOUNG, Director,
Lake of the Woods Reduction Works Co.



THE CRAWFORD MILL.